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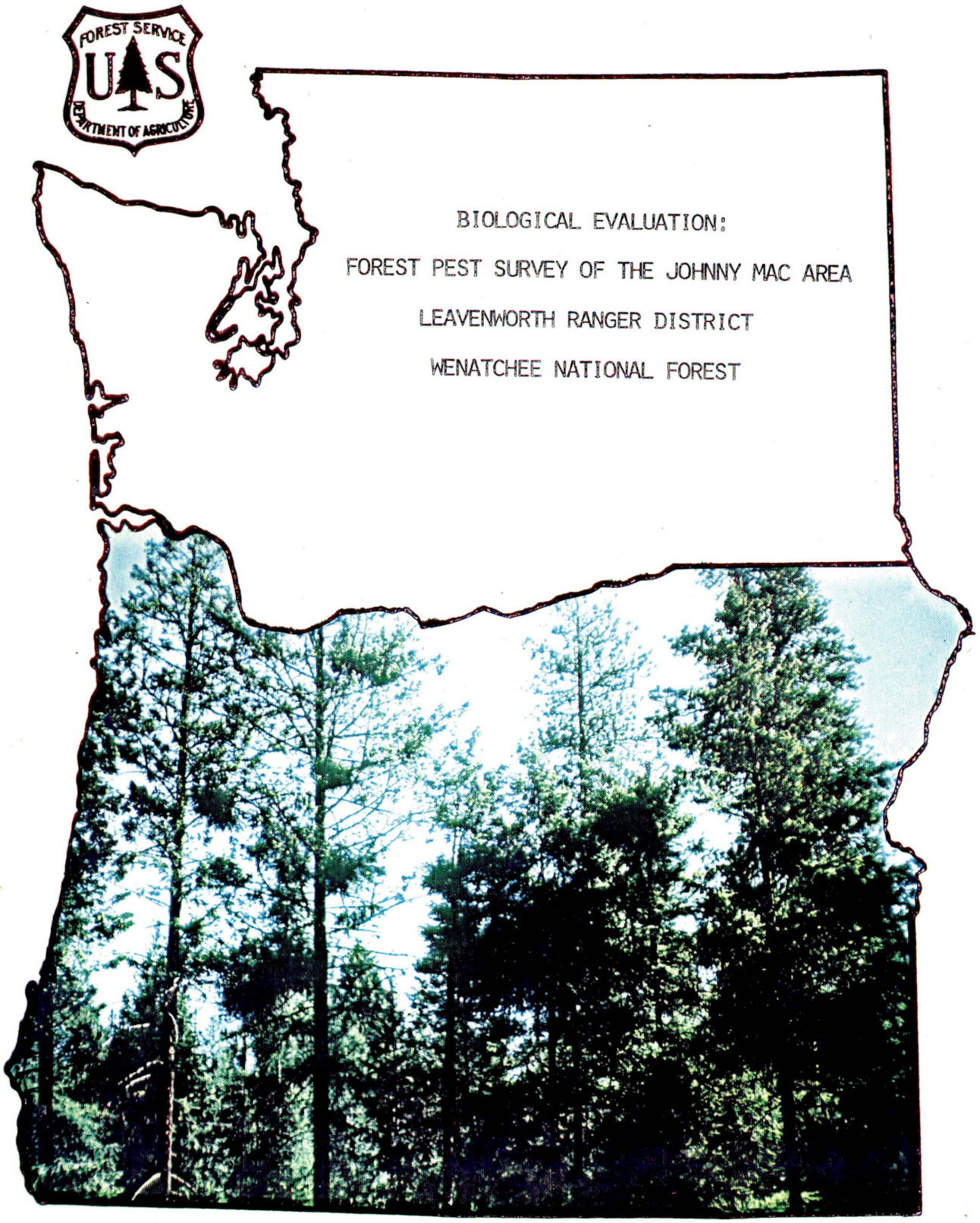
Forest Pest Management
Pacific Northwest Region



BIOLOGICAL EVALUATION:

FOREST PEST SURVEY OF THE JOHNNY MAC AREA

LEAVENWORTH RANGER DISTRICT

WENATCHEE NATIONAL FOREST

FOREST PEST SURVEY OF THE JOHNNY MAC AREA
LEAVENWORTH RANGER DISTRICT, WENATCHEE NATIONAL FOREST

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INTRODUCTION

During the week of May 13 to 16, the Forest Pest Management Pathology Group did a pest evaluation of seven stands in the Johnny Mac area T. 24 N., R. 16 E., secs. 2 and 10 on the Leavenworth Ranger District (Fig. 1). These stands had been tentatively identified by the District as having severe pest-caused damage. Purposes of the present evaluation were to determine amount and cause of damage, ascertain whether pests in the stands posed any threat to adjacent stands, and provide management alternatives to minimize future losses in the areas.

METHODS

Stands were surveyed systematically using a variable plot cruise technique. A Spiegel Relaskop was employed to define plots (BAF Standard = 40), and plots were located on a 5 x 2 chain grid across each stand. Using this spacing, approximately one plot per acre was established in each surveyed unit. In the plots, the following information was recorded for all "in" trees: species, DBH, general condition (live, dead, standing, down) and, where appropriate, diseases or insects present. Two roots on opposite sides of all recently dead or symptomatic plot trees were excavated to a distance of 3 feet from the root collar and examined for evidence of stain, decay, or fungus mycelia. Roots and butts of old dead trees were dissected to determine character of wood decay. Trunks were examined for signs and symptoms of stem decay, and crowns were investigated for evidence of foliage diseases and mistletoes. Bark was removed from stems of bark beetle-infested trees to expose galleries for beetle species determination. From data collected in plots, stand tables were prepared for each unit. In addition to collecting plot data, the survey crew reconnoitered areas between plots and lines and delineated severely root-diseased areas on unit maps.

RESULTS AND DISCUSSION

Results of the surveys showed that most of the stands did indeed have substantial amounts of pest damage. A stand-by-stand description is as follows:

STAND 10-A - This stand is dominated by grand fir, contains some Douglas-fir and lodgepole pine, and has minor amounts of western white pine, western red cedar, western hemlock, and Engelmann spruce. Thirty-five percent of all trees in the stand (containing 39 percent of the basal area) are dead. Grand fir and Douglas-fir are suffering extremely high levels of root disease. Most is laminated root rot, caused by the fungus Phellinus weirii, though there is

also some Armillaria root disease, caused by Armillaria ostoyae, and a small amount of Annosus root disease caused by Fomes annosus. Thirty-one percent ofthe grand fir and 43 percent of the Douglas-fir are affected. Root disease occurs mostly in the western two-thirds of the unit (Fig. 2). In addition to root diseases, evidence of several other pests occurs in the stand. All living Douglas-fir are infected by Douglas-fir dwarf mistletoe (Arceuthobium douglasii). Also, in addition to infesting many root-diseased trees, Douglas-fir beetles (Dendroctonus pseudotsugae) have killed some disease-free Douglas-fir. Lodgepole and western white pine exhibit mortality caused by mountain pine beetle (Dendroctonus ponderosae), and western white pine shows evidence of infection by white pine blister rust caused by Cronartium ribicola. Table 1 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 10-A.

STAND 10-B - Major components of this stand are grand fir and Douglas-fir. There are also some western white pine and Engelmann spruce. Thirty-eight percent of the trees in the stand (accounting for 43 percent of the basal area) are dead. Armillaria root disease is detectable on 4 percent of the grand fir and 30 percent of the Douglas-fir. Sixty-five percent of the living Douglas-fir and 22 percent of the dead Douglas-fir have dwarf mistletoe infections. Douglas-fir beetle infestation also accounts for a substantial amount of mortality, 36 percent of the dead Douglas-fir. A small amount of white pine blister rust occurs in the unit. Table 2 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 10-B.

STAND 10-C - This stand is dominated by Douglas-fir and contains a small amount of grand fir. Seventy percent of all trees (representing 63 percent of the basal area) are dead. Seventy-five percent of the mortality is attributable to Douglas-fir beetle, and the remainder is associated with Armillaria root disease. There is some Douglas-fir dwarf mistletoe in the stand. Table 3 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 10-C.

STAND 10-D - This stand is comprised mainly of grand fir and Douglas-fir but also has small amounts of western redcedar, lodgepole pine, and ponderosa pine. Fifty-two percent of all trees (accounting for 42 percent of the basal area) are dead. Armillaria root disease and laminated root rot occur across the entire unit at very high levels. Forty-two percent of the grand fir and 34 percent of the Douglas-fir are affected by root diseases. Douglas-fir dwarf mistletoe is common in the stand, affecting 66 percent of the living and 31 percent of the dead Douglas-fir. Also, Douglas-fir beetles have been active in the stand, by themselves accounting for 20 percent of the dead Douglas-fir. Table 4 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 10-D.

STAND 2-1 - Douglas-fir and grand fir predominate in this stand, but there are also some ponderosa and lodgepole pine. Fifty-three percent of the trees (containing 50 percent of the basal area) are dead. Laminated root rot occurs throughout this stand and is severe, affecting 61 percent of the grand fir and 51 percent of the Douglas-fir. Douglas-fir dwarf mistletoe is also common in the stand. Thirty-one percent of the living Douglas-fir are infected. Table 5 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 2-1.

STAND 2-2 - This stand is composed mainly of grand fir, has some Douglas-fir, and contains a small number of large, old ponderosa pine. It differs from the other surveyed stands in showing very little tree mortality. Only 2 percent of the trees (representing 9 percent of the basal area) are dead. Laminated root rot has an extremely limited distribution along the southern boundary of the stand. Six percent of the Douglas-fir are affected. Thirty percent of the living Douglas-fir are infected by Douglas-fir dwarf mistletoe. Table 6 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 2-2.

STAND 2-3 - This stand is dominated by Douglas-fir, contains some ponderosa pine, and has a trace of grand fir. Forty-one percent of all trees (accounting for 33 percent of the basal area) are dead. Most of the dead trees are Douglas-fir, and most of the mortality (35 percent of all Douglas-fir) appears to have been caused by Dougas-fir beetles, either by themselves or acting with Armillaria root disease. Twenty-six percent of the living Douglas-fir are infected by dwarf mistletoe. Mountain pine beetle and Armillaria root disease have contributed to ponderosa pine mortality. Table 7 summarizes tree numbers and basal area per acre by species, size, condition, and cause of pest damage in Stand 2-3.

When considering whether or not pests in evaluated areas pose a hazard to surrounding stands or have the potential to cause continuing mortality in the surveyed stands, the biologies and especially the processes and rates of spread of the particular pathogens and insects involved in each unit must be taken into consideration. The following is a discussion of each of the major pests encountered in the surveys:

Laminated Root Rot - Phellinus weirii, cause of laminated root rot, extensively decays root systems of infected hosts, causing death by windthrow or loss of ability to obtain water and nutrients. Laminated root rot is identified readily by the typical wood decay that separates easily at the growth rings, the reddish, whiskery setal hyphae that appear between the sheets of rotted wood, and the grayish, crusty ectotrophic mycelia produced on root bark.

Laminated root rot is a particularly dangerous disease, not only because of its devastating effects on susceptible hosts, but also because the causal pathogen is persistent on the site. The fungus can survive for up to 50 years in roots of dead stubs or stumps and infect, via root contacts, new hosts that become established on the site. Existing infection centers, such as those encountered in the survey, increase in size due to mycelial spread by the fungus from tree-to-tree across root contacts. The pathogen spreads at a rate of about 1.5 feet per year. Because of its root-to-root spread and capacity to survive and reinfect, laminated root rot definitely poses a threat to healthy stands of susceptible tree species in the immediate vicinity of diseased areas and will continue to cause damage in already infected stands indefinitely if not treated. In this evaluation, the western two-thirds of Stand 10-A, all of Stand 10-D, and all of Stand 2-1 are severely infected. As now delineated, these units border uninfected areas.

Laminated root rot affects all conifers but there are considerable differences in degree of damage. Grand fir and Douglas-fir are highly susceptible. they are readily infected and killed by Phellinus weirii. Western hemlock, Engelmann spruce, and western larch are intermediately susceptible. They are often infected but infrequently killed by the pathogen. The pines and cedars are tolerant or resistant to Phellinus weirii. They are rarely infected and almost never killed. All hardwoods are immune to laminated root rot.

Recommended control for laminated root rot is to harvest all susceptible hosts in infection centers and within a 50-foot buffer around each and either (1) leave inoculum but replant with immune, tolerant, resistant, or intermediately susceptible tree species that are adapted to the site or (2) mechanically remove all inoculum (infected roots and stumps) with heavy equipment. The species manipulation alternative is usually the best control option because of lower cost and less likelihood of causing serious damage to soil on steep slopes.

Armillaria Root Disease - Armillaria ostoyae, cause of Armillaria root disease, usually kills standing trees by destroying a major portion of the cambium around the root collar. It occasionally decays enough of the root system to contribute to windthrow. Armillaria root disease identification is based on the characteristic thick, white mycelial fans under the bark of affected host roots and lower stems, the associated rhizomorphs, and the stringy, yellow decay.

Armillaria ostoyae is a very efficient saprophyte that survives almost everywhere in old stumps and roots. It can infect nearby trees via root contacts or by growing a short distance through the soil. Like Phellinus weirii, the fungus spreads at a rate of about 1.5 feet per year. Different strains of Armillaria ostoyae display different levels of virulence toward living trees. Many including those in the survey area, are rather weak pathogens that affect mostly stressed and injured trees. In surveyed stands, Armillaria ostoyae was mostly detected on trees also affected by other pathogens (Douglas-fir dwarf mistletoe in Stands 10-B and 10-D, laminated root rot in Stand 10-D) or in areas with numerous seeps associated with drainage problems (Stands 10-D and 2-3). Many stands in the survey area were severely defoliated by western spruce budworm (Choristoneura occidentalis) in the 1970's. Severe defoliation can make trees more susceptible to infection by Armillaria ostoyae. Spread of Armillaria root disease into surrounding stands or continued damage in stands already affected will occur mainly in low vigor trees. Hazard is considerably less than with Phellinus weirii.

Armillaria root disease can affect any tree species. However, in East Side Washington stands, it is usually most common on grand fir and Douglas-fir. Western hemlock, Englemann spruce, western larch, and the pines are usually not affected unless severely stressed.

Recommended control for Armillaria root disease in mature stands is to harvest affected hosts and regenerate with less susceptible hosts of good vigor that are well adapted to the site. Activities that ameliorate stressful site conditions are also recommended.

Douglas-fir Dwarf Mistletoe - Arceuthobium douglasii is a parasitic higher plant that obtains most of its food and all of its water from the Douglas-fir host. Dwarf mistletoe infection debilitates the host, causing considerable growth loss, frequent top-killing, predispostion to bark beetles, and not uncommonly tree death. In addition, the systemic infections of Douglas-fir dwarf mistletoe cause dramatic crown and stem distortions. The disease is identified by the branch swellings in the host crown with small, yellow-green mistletoe plants protruding and by the charateristic large, dense witches'-brooms produced by the host at sites of infection.

Douglas-fir dwarf mistletoe spreads by forcibly discharged seeds that are shot out from mistletoe plants in an overstory and fall onto susceptible trees in the understory. The average distance that Douglas-fir dwarf mistletoe seeds are cast is 10 feet and the maximum is 40 feet. Douglas-fir dwarf mistletoe has great potential for continuing damage in already infected Douglas-fir stands and also poses a definite hazard to uninfected stands adjacent to stands with the disease. In the survey area, Stands 10-B and 10-D have particularly high levels of dwarf mistletoe infection; Stands 10-A, 2-1, and 2-3 have high levels of infection; and Stands 10-C and 2-2 have light to moderate levels of infection. Uninfected stands occur along one or more boundaries of all stands as they are currently delineated.

Douglas-fir dwarf mistletoe only infects Douglas-fir and the pathogen only survives on living trees. Thus, recommended control involves harvesting all susceptible hosts in the stand. The unit can be regenerated with any tree species including Douglas-fir.

Douglas-fir Beetle - Dendroctonus pseudotsugae kills trees by physically girdling them and by introducing blue stain fungi (Ceratocystis spp.) that plug water-conducting vessels. Douglas-fir beetles are identified by their long, vertical adult galleries with alternating groups of horizontally branching larval galleries.

For the most part, Douglas-fir beetles are not primary tree killers. Rather, they usually attack and breed in severely weakened or windthrown trees. In the evaluated stands, they were found infesting some trees weakened by pathogens or environmental stress. However, the greatest concentrations of beetle-caused mortality (in Stands 10-B, 10-C, and 2-3) were associated with heavily stocked, medium-sized Douglas-fir (basal area in excess of 150 square feet per acre; average tree size 10- to 20-inches DBH) that had a history of defoliation by western spruce budworm. Trees in such stands were undoubtedly predisposed to beetle infestation as the result of defoliation-induced stress combined with the effects of greater than normal intertree competition. Unfortunately, large patches of trees have been killed, leaving substantial unstocked areas in the stands.

Douglas-fir beetle infestation occurred 2-3 years ago in survey stands. Douglas-fir beetles from that particular infestation are now gone and pose no continuing threat to stands where they formerly occurred nor to surrounding stands. Recommended control for Douglas-fir beetle involves preventing development of stand conditions favorable for infestation. This is done through stocking control and favoring of nonsusceptible tree species in a mix with Douglas-fir, but these steps must be taken prior to infestation.

Infested trees can be salvaged before new brood emerges to prevent spread to adjacent stands but this requires good access and careful monitoring. Infested trees must be removed before April of the year following infestation to eliminate brood emergence.

SPECIFIC MANAGEMENT RECOMMENDATIONS

Surveyed stands in the Johnny Mac area generally exhibit very high levels of pest damage (well above average for the Region). Stands tend to be dominated by grand fir and Douglas-fir, the most damage-prone species in eastern Washington. Pests, especially laminated root rot, and Douglas-fir dwarf mistletoe, pose a continuing hazard to already affected stands and, in many cases, to adjacent unaffected stands. Forest Pest Management recommends the following specific prescriptions for surveyed stands:

1. Stands 10-D, 2-1, and the western two-thirds of Stand 10-A should be clearcut and regenerated with tree species intermediately susceptible, tolerant, resistant, or immune to laminated root rot.

2. The eastern one-third of Stand 10-A, Stand 10-B, and Stand 2-3 should be clearcut and regenerated with any tree species adapted to the site.

3. Stand 10-C, though it has suffered considerable Douglas-fir mortality due to Douglas-fir beetle, has little potential for continued mortality and poses no threat to surrounding stands. It requires no pest treatment. However, large numbers of dead trees in this stand may constitute a fire hazard.

4. Stand 2-2 does not appear to be suffering high enough levels of pest damage to require immediate treatment.

5. Heavily stocked Douglas-fir stands with average tree diameters between 10 and 20 inches in the vicinity of the evaluation area have the potential for Douglas-fir beetle infestation if they are stressed by such factors as western spruce budworm defoliation. If possible, consideration should be given to thinning such stands and developing a species mix (especially with pines, larch, or cedars).

6. When regenerating harvested stands in the evaluation area, if western white pine is a desired species, use stock that has been screened for resistance to white pine blister rust. If appropriate sample material is available, sites should be rated for white pine blister rust infection hazard before planting white pine.

7. When ponderosa, lodgepole, or western white pine are used as major components in regenerating stands in the evaluation area, try to keep stand basal areas below 150 square feet per acre through subsequent thinnings.

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Table 1: Mean number of trees and square foot basal area (in parenthesis) per acre by tree species, condition, and diameter class for Stand 10-A.

	GRAND FIR				DOUGLAS-FIR				LODGEPOLE PINE		WESTERN REDCEDAR	WESTERN WHITE PINE			WESTERN HEMLOCK	ENGELMANN SPRUCE
	Live		Dead		Live		Dead		Live	Dead	Dead	Live	Dead		Live	Live
Diameter Class	Healthy	Root Disease-Affected	Unknown	Root Disease-Affected	Healthy	Dwarf Mistletoe-Affected	Beetles	Root Disease-Affected	Healthy	Beetles	Root Disease-Affected	Healthy	Blister Rust	Beetles	Healthy	Healthy
6	64.4(12.6)	0	10.7(2.1)	42.9(8.4)	0	0	0	0	0	0	0	0	0	0	0	0
8	48.3(16.8)	0	0	12.0(4.2)	0	0	0	0	6.0(2.1)	0	0	0	0	0	0	0
10	11.6(6.3)	3.9(2.1)	0	0	0	0	0	0	7.7(4.2)	3.9(2.1)	3.9(2.1)	0	0	0	3.9(2.1)	3.9(2.1)
12	5.4(4.2)	0	0	2.7(2.1)	0	0	0	0	0	0	0	0	0	2.7(2.1)	0	0
14	0	0	3.9(4.2)	2.0(2.1)	0	2.0(2.1)	0	0	7.9(8.4)	0	0	0	0	0	0	0
16	7.5(10.5)	1.5(2.1)	0	3.0(4.2)	0	1.5(2.1)	3.0(4.2)	1.5(2.1)	3.0(4.2)	0	0	3.0(4.2)	0	0	0	0
18	0	0	1.2(2.1)	2.4(4.2)	0	0	0	1.2(2.1)	0	0	0	0	0	0	0	0
20	1.0(2.1)	0	0	0	0	0	0.8(2.1)	1.9(4.2)	0	0	0	0	0	0	0	0
22	0.8(2.1)	0	0	0	0	0	0	0.8(2.1)	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0.6(2.1)	0	0	0	0	0.6(2.1)	0	0.6(2.1)	0	0	0	0	0	0	0	0
28	0.5(2.1)	0	0	0	0	0	0	0	0	0	0	0	0.5(2.1)	0	0	0
Total All Classes	140.1(58.8)	5.4(4.2)	15.8(8.4)	65.0(25.2)	0(0)	4.1(6.3)	3.8(6.3)	6.0(12.6)	24.6(18.9)	3.9(2.1)	3.9(2.1)	3.0(4.2)	0.5(2.1)	2.7(2.1)	3.9(2.1)	3.9(2.1)

Table 2: Mean number of trees and square foot basal area (in parenthesis) per acre by diameter class, species, and tree condition for Stand 10-B.

	GRAND FIR			DOUGLAS-FIR					WESTERN WHITE PINE			ENGLEMANN SPRUCE
	Live	Dead		Live		Dead			Live	Dead		Live
Diameter Class	Healthy	Unknown	Root Disease-Affected	Healthy	Mistletoe-Affected	Beetles	Root Disease-Affected	Mistletoe-Infected	Healthy	Blister Rust	Root Disease-Affected	Healthy
6	36.0(7.1)	36.0(7.1)	0	0	0	0	0	0	0	0	0	0
8	40.5(14.1)	0	6.7(2.3)	0	0	0	0	0	0	0	0	0
10	25.9(14.1)	12.9(7.1)	0	0	0	4.3(2.3)	8.6(4.7)	0	12.(2.3)	0	0	0
12	15.0(11.8)	3.0(2.3)	0	3.0(2.3)	0	0	0	0	0	0	0	0
14	2.2(2.3)	2.2(2.3)	0	2.2(2.3)	2.2(2.3)	6.6(7.1)	4.4(4.7)	2.2(2.3)	0	2.2(2.3)	2.2(2.3)	0
16	10.1(14.1)	0	1.7(2.3)	0	1.7(2.3)	1.7(2.3)	1.7(2.3)	0	0	1.7(2.3)	0	0
18	2.7(4.7)	0	0	0	2.7(4.7)	1.3(2.3)	0	1.3(2.3)	0	0	0	0
20	2.2(4.7)	0	0	0	0	0	1.1(2.3)	0	0	0	0	0
22	0	0	0	0	1.8(4.7)	0	0	2.7(7.1)	0	0	0	0
24	0.7(2.3)	0	0	0	0	0.7(2.3)	0	2.3(7.1)	0	0.7(2.3)	0	0.7(2.3)
26	0	0	0	0	0.6(2.3)	0	0.6(2.3)	0	0	0	0	0
28	0	0	0	0	0	0	0	0.5(2.3)	0	0	0	0
30	0	0	0	0	0.5(2.3)	0	0	0	0.5(2.3)	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0.3(2.3)	0	0	0	0	0	0	0
Total All Classes	135.3(75.2)	54.1(18.8)	8.4(4.6)	5.2(4.6)	9.8(20.9)	14.6(16.3)	16.4(16.3)	9.0(21.1)	12.5(4.6)	4.6(6.9)	2.2(2.3)	12.7(4.6)

Table 3: Mean number of trees and square foot basal area (in parenthesis) per acre tree species, condition, and diameter class for Stand 10-C.

Diameter Class	GRAND FIR Live	DOUGLAS-FIR Live		DOUGLAS-FIR Dead	
	Healthy	Healthy	Mistletoe Affected	Beetles	Root Disease-Affected
6	0	0	0	34.0(6.7)	0
8	19.1(6.7)	19.1(6.7)	0	0	19.1(6.7)
10	0	0	0	12.2(6.7)	12.2(6.7)
12	8.5(6.7)	0	0	59.4(46.7)	8.5(6.7)
14	0	12.5(13.3)	0	12.5(13.3)	0
16	0	4.8(6.7)	0	19.1(26.7)	4.8(6.7)
18	0	7.5(13.3)	0	3.8(6.7)	0
20	0	6.1(13.3)	0	3.1(6.7)	0
22	0	2.5(6.7)	0	0	2.5(6.7)
24	0	0	0	0	0
26	0	0	0	0	0
28	0	0	0	0	0
30	0	0	0	0	0
32	0	0	0	0	0
34	0	0	0	0	0
36	0	0	0	0	0
38	0	0	0	0	0
40	0	0	0	0	0
42	0	0	0.7(6.7)	0	0
44	0	0	0.6(6.7)	0	0
Total All Classes	27.6(13.4)	52.5(60.0)	1.3(13.4)	144.1(113.5)	47.1(33.5)

Table 4: Mean number of trees and square foot basal area (in parenthesis) per acre by tree species, condition, and diameter class for Stand 10-D.

	GRAND FIR			DOUGLAS-FIR					LODGEPOLE PINE	PONDEROSA PINE	WESTERN REDCEDAR
	Live	Dead		Live		Dead			Live	Live	Live
Diameter Class	Healthy	Unknown	Root Disease-Affected	Healthy	Mistletoe-Affected	Beetles	Root Disease-Affected	Mistletoe-Affected	Healthy	Healthy	Healthy
6	14.6(2.9)	0	14.6(2.9)	0	0	0	8.2(2.9)	0	0	0	0
8	16.4(5.7)	0	8.2(2.9)	0	0	0	0	0	0	0	0
10	0	5.2(2.9)	0	0	0	0	0	5.2(2.9)	0	0	0
12	3.6(2.9)	0	10.9(8.6)	0	0	0	0	0	0	0	0
14	5.3(5.7)	2.7(2.9)	5.3(5.7)	0	0	2.7(2.9)	0	2.7(2.9)	0	0	0
16	10.2(14.3)	0	0	4.1(5.7)	0	0	0	0	0	0	0
18	4.8(8.6)	0	6.4(11.4)	0	4.8(8.6)	1.6(2.9)	1.6(2.9)	0	1.6(2.9)	0	0
20	2.6(5.7)	0	3.9(8.6)	0	0	0	2.6(5.7)	0	0	0	0
22	4.3(11.4)	0	1.1(2.9)	0	0	0	0	0	0	0	0
24	3.6(11.4)	0	2.7(8.6)	0	1.8(5.7)	0.9(2.9)	0	0	0	0	0.9(2.9)
26	0.8(2.9)	0	0.8(2.9)	0	0.8(2.9)	0	0	0	0	0	0
28	0.7(2.9)	0.7(2.9)	0.7(2.9)	0	0	0	0.7(2.9)	0.7(2.9)	0	0	0
30	1.2(5.7)	0	0.6(2.9)	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0.5(2.9)	0
34	0	0	0	0	0	0	0.4(2.9)	0	0	0	0
36	0	0	0	0	0.4(2.9)	0	0	0	0	0	0
38	0	0	0	0	0	0.4(2.9)	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0.3(2.9)	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0
46	0.2(2.9)	0	0	0	0	0	0	0	0	0	0
Total All Classes	68.3(83.0)	8.6(8.7)	55.2(60.3)	4.1(5.7)	8.1(23.0)	5.6(11.6)	13.5(17.3)	8.6(8.7)	1.6(2.9)	0.5(2.9)	0.9(2.9)

Table 5: Mean number of trees and square foot basal area (in parenthesis) per acre by tree species, condition, and diameter class for Stand 2-1.

	GRAND FIR		DOUGLAS-FIR					PONDEROSA PINE		LODGEPOLE PINE
	Live	Dead	Live			Dead		Live	Dead	Live
Diameter Class	Healthy	Root Disease-Affected	Healthy	Mistletoe-Affected	Root Disease-Affected	Mistletoe-Affected	Root Disease-Affected	Healthy	Beetles	Healthy
6	0	31.4(6.1)	31.4(6.1)	0	0	0	31.4(6.1)	0	0	0
8	8.8(3.1)	0	0	8.8(3.1)	0	0	8.8(3.1)	0	0	0
10	5.6(3.1)	0	11.3(6.1)	0	0	0	5.6(3.1)	0	0	11.3(6.1)
12	7.8(6.1)	0	0	0	3.9(3.1)	0	0	0	0	3.9(3.1)
14	0	2.9(3.1)	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	4.4(6.1)
18	0	0	0	0	0	0	0	0	0	0
20	0	0	0	1.4(3.1)	0	0	1.4(3.1)	0	0	0
22	0	0	0	0	0	0	1.2(3.1)	0	0	0
24	0	0	0	1.0(3.1)	0	0	2.0(6.1)	0	0	0
26	0	0	0	0	0	0.8(3.1)	0.8(3.1)	0	0	0
28	0	0	0	0	0	0	2.2(9.2)	0.7(3.1)	0	0
30	0	0	0	0	0	0	0	0.6(3.1)	0	0
32	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0.5(3.1)	0.5(3.1)	0	0
36	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0.4(3.1)	0
40	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0.3(3.1)	0
Total All Classes	22.2(12.3)	34.3(9.2)	42.7(12.2)	11.2(9.3)	3.9(3.1)	0.8(3.1)	53.9(40.0)	1.8(6.2)	0.7(6.2)	19.6(15.3)

Table 6: Mean number of trees and square foot basal area (in parenthesis) per acre by tree species, condition, and diameter class for Stand 2-2.

Diameter Class	GRAND FIR Live	DOUGLAS-FIR Live		DOUGLAS-FIR Dead	PONDEROSA PINE Live
	Healthy	Healthy	Mistletoe-Affected	Root Disease-Affected	Healthy
6	34.0(6.7)	0	0	0	0
8	19.1(6.7)	0	0	0	0
10	24.5(13.3)	0	0	0	0
12	25.5(20.0)	8.5(6.7)	0	0	0
14	12.5(13.3)	6.2(6.7)	6.2(6.7)	0	0
16	4.8(6.7)	14.3(20.0)	0	0	0
18	11.3(20.0)	3.8(6.7)	0	0	0
20	3.1(6.7)	0	6.1(13.3)	0	0
22	0	2.5(6.7)	0	0	0
24	0	0	0	0	0
26	0	0	1.8(6.7)	0	0
28	0	0	0	1.6(6.7)	0
30	0	0	0	0	2.7(13.3)
32	1.2(6.7)	0	1.2(6.7)	1.2(6.7)	0
34	0	1.1(6.7)	0	1.1(6.7)	1.1(6.7)
36	0	0	0	0	0
38	0	0	0	0	0
40	0	0	0	0	0
42	0	0	0.7(6.7)	0	0
Total All Classes	136.0(100.1)	36.4(53.5)	16.0(40.1)	3.9(20.1)	3.8(20.0)

Table 7: Mean number of trees and square foot basal area (in parenthesis) per acre by tree species, condition, and diameter class for Stand 2-3.

Diameter Class	GRAND FIR	DOUGLAS-FIR					PONDEROSA PINE		
	Live	Live		Dead			Live	Dead	
	Root Disease-Affected	Healthy	Mistletoe-Affected	Unknown	Beetles	Root Disease-Affected	Healthy	Beetles	Root Disease-Affected
6	0	8.5(1.7)	8.5(1.7)	8.5(1.7)	0	8.5(1.7)	0	0	0
8	0	14.3(5.0)	0	0	0	0	0	0	0
10	0	0	0	3.1(1.7)	0	6.2(3.3)	3.1(1.7)	0	0
12	0	10.6(8.3)	6.4(5.0)	0	6.4(5.0)	0	0	2.1(1.7)	2.1(1.7)
14	0	3.1(3.3)	0	0	7.8(8.3)	0	0	3.1(3.3)	0
16	1.2(1.7)	7.2(10.0)	1.2(1.7)	0	9.5(13.3)	1.2(1.7)	1.2(1.7)	2.4(3.3)	0
18	0	8.5(15.0)	1.9(3.3)	0	0	0	0	0	0
20	0	3.8(8.3)	1.5(3.3)	0	1.5(3.3)	0	0	0	0
22	0	2.5(6.7)	0.6(1.7)	0	0.6(1.7)	0	0	0	0
24	0	0	0	0	0	0	0	0	0
26	0	0.4(1.7)	0.9(3.3)	0	0	0	0	0	0
28	0	0.4(1.7)	0.4(1.7)	0	0	0	0.8(3.3)	0	0
30	0	0.3(1.7)	0	0	0	0	0	0	0
32	0	0	0.3(1.7)	0	0	0	0.3(1.7)	0	0
34	0	0	0.3(1.7)	0	0	0.3(1.7)	0	0	0
36	0	0	0.2(1.7)	0	0	0	0.2(1.7)	0	0
38	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0.2(1.7)	0	0
46	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0.3(3.3)	0	0
50	0	0	0.1(1.7)	0	0	0	0	0	0
Total All Classes	1.2(1.7)	59.6(63.4)	22.3(28.5)	11.6(3.4)	25.8(31.6)	16.2(8.4)	6.1(15.1)	7.6(8.3)	2.1(1.7)

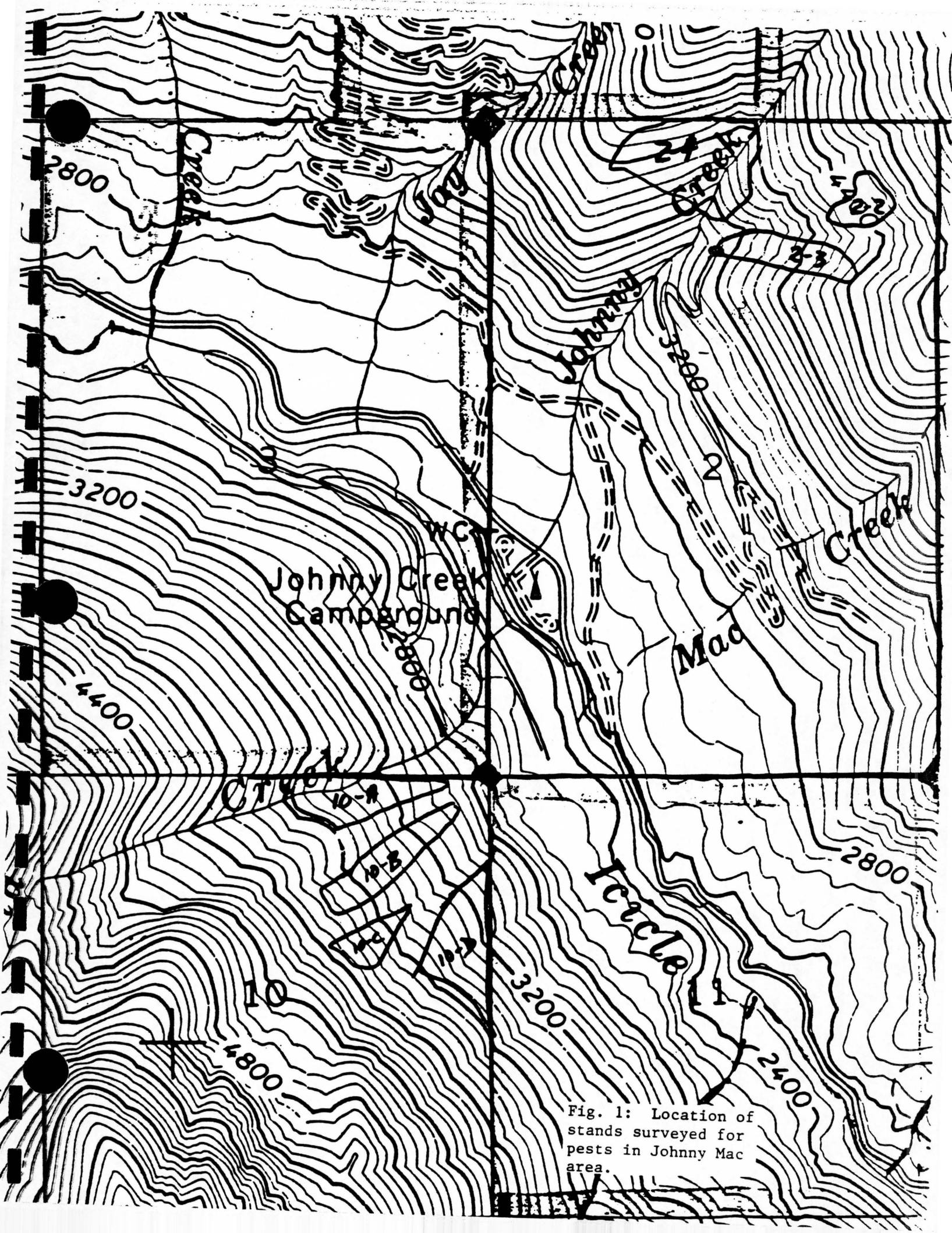

Fig. 1: Location of stands surveyed for pests in Johnny Mac area.

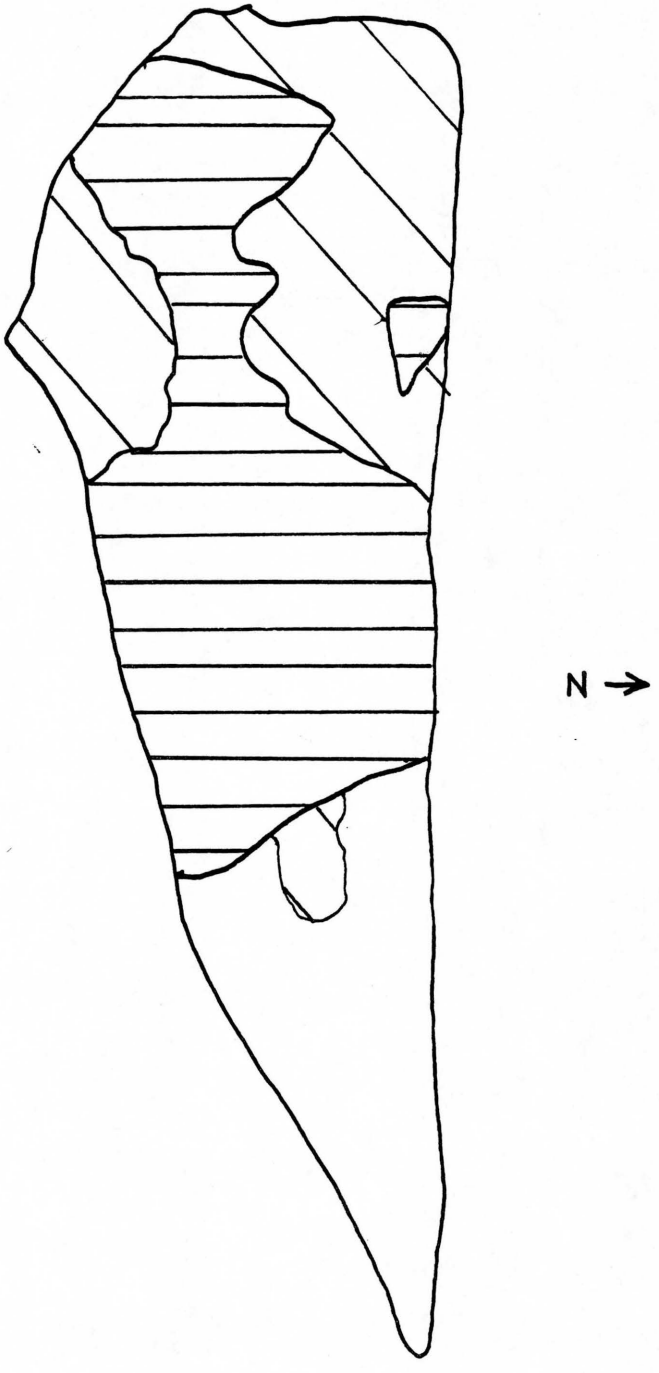

Fig. 2: Map of stand 10-A showing distribution of laminated root rot (horizontal hashing) and Armillaria root disease (both horizontal and cross hatching) in the unit.